bring scientific knowledge, in a popular form, before societies unable to pay large fees for professional lectures, and all fees paid for lectures are devoted to the working expenses of the section. Applications for the list by the secretaries of natural history and kindred societies should be made to the honorary secretary of the extension section of the Manchester Microscopical Society at 22 Filey Road, Fallowfield, Manchester.

MESSRS. WRATTEN AND WAINWRIGHT have sent us a batch of their panchromatic plates, which have been recently prepared in response to the demand for a plate having more uniform sensitiveness to the various spectral colours. Very searching tests on photographs of various spectral radiations show conclusively the unique qualities of the new emulsion. For instance, on a photograph of the spectrum of the iron arc the green region, usually difficult to obtain with such exposures as give the blue of normal density, is shown of actually greater density than the blue; at the same time, the red end of the spectrum is very uniformly rendered up to λ 7600, and with slightly longer exposure somewhat beyond this. This particular batch of plates was of medium rapidity, the sensitiveness measured to daylight being 94 H and D, 138 Watkins and F/94 Wynne. Development took about 3 minutes for most of the exposures tried, and the plates were clear and clean in working. An important factor in spectroscopic work is the fineness of the grain of the silver deposit, and in this respect the Wratten panchromatic is excellent. There is no doubt that for spectrum investigation extending over the whole region from ultraviolet to extreme red these plates are the most satisfactory at present obtainable. If one might be permitted to ask for further convenience, it would be to maintain the present colour sensitiveness ratios, and endeavour to increase the general rapidity. Should it be found possible to do this and, at the same time, keep the grain within reasonable bounds, this type of emulsion would be of immense service for stellar spectrum photography, as for this purpose a rapid plate is essential on account of the feebleness of the light. A notable feature of the instructions sent out with the plates is the provision (for the first time, so far as we are aware) of a table showing the normal time of development for varying temperatures. It is well known that the temperature of the developing solution has a considerable effect on the speed of appearance and subsequent growth of the latent image, and as the new plates are practically equally sensitive to all colours, requiring development in darkness, it is very advantageous to be able to control by time the correct duration of the process. The figures given for this purpose are not arbitrary, but have been obtained from exhaustive experimental trials, and can therefore be relied on without hesitation to give comparatively uniform results. The developer recommended is a very weak combination of metol hydroquinone, but excellent results have been obtained with other ordinary developers, some much more concentrated, so that no difficulty is likely to be found from this cause when the time best suited to the developer chosen is once determined.

Two more parts of Prof. O. D. Chwolson's "Traité de Physique," which M. A. Davaux is translating into French from the Russian and German editions, have been published in Paris by M. A. Hermann. The first parts of vols. i. and ii. were reviewed at length in our issue for February 15 last (vol. lxxiii., p. 362), and the present fascicles are the second parts of these volumes. The former deals with the gaseous state of bodies, and the latter with indices of refraction and the dispersion and transformations of radiant energy. As in the volumes reviewed on a previous occasion, the two new parts are provided with notes on theoretical physics by MM. E. and F. Cosserat.

PROF. H. ERDMANN'S "Lehrbuch der anorganischen Chemie," the fourth edition of which has just been published by Messrs. F. Vieweg and Son, Brunswick, is a comprehensive text-book containing nearly eight hundred pages and three hundred figures. The work presents a concise statement of the present position of inorganic chemistry; it should be of service, not only to students of chemistry, but also to those concerned with the study or progress of other branches of pure and applied science.

OUR ASTRONOMICAL COLUMN.

COMET 1906*d*.—From an observation made at Lyons on July 21, M. J. Guillaume recorded that Finlay's comet, on that date, had a nebulous appearance with diffuse edges, and that the central condensation was of the twelfth magnitude, the magnitude of the whole object being 11·5.

The observation also showed that the position given by M. Schulhof's ephemeris for that date needed but small corrections; a further abstract from the ephemeris is given below:—

Ephemeris (12*h. M.T. Paris*).

1906	α (app.) h. m. s.	δ (app.) ° ′	log Δ	$1 : r^2\Delta^2$
Aug. 26 ...	5 6 19 ...	+14 31 ...	9·50197 ...	10·25
28 ...	5 18 7 ...	+15 18 ...	9·51725 ...	9·66
30 ...	5 29 17 ...	+15 59 ...	9·53258 ...	9·08
Sept. 1 ...	5 39 51 ...	+16 37 ...	9·54783 ...	8·53

The comet will pass about 1° south of 15 Orionis on August 26 (*Astronomische Nachrichten*).

A MEMORIAL TO THE LATE PROF. TACCHINI.—From No. 7, vol. xxxv., of the *Memorie della Società degli Spettroscopisti Italiani*, we are pleased to learn that an international subscription list has been opened for the purpose of founding some lasting souvenir in honour of that great Italian astronomer the late Prof. Tacchini.

A circular letter to this end has, evidently, already been addressed to the members of the society which he founded, and a goodly sum thus realised, but not sufficient to fulfil the object aimed at in a manner worthy of the occasion.

No doubt the fellow-workers and admirers of Pietro Tacchini, who did so much for the cause of astronomy, will be glad to have this matter brought to their notice, and to help forward the scheme. Subscriptions should be addressed to Prof. L. Palazzo, Directeur du Bureau Central de Météorologie et Géodynamique, Rome.

REPORT OF THE PARIS OBSERVATORY FOR 1905.—Although M. Lœwy, in opening his report of the work done at the Paris Observatory during the year 1905, mentions that observations were curtailed owing to the preparations for the total eclipse of the sun, the lamented death of M. Paul Henry, the necessary alterations to the principal meridian circle, and other causes, it appears from the report itself that a great deal of work was prosecuted during the year.

The publications included twenty-seven sheets of the "Cart du Ciel" showing images of 39,697 stars, the ninth part of the photographic atlas of the moon, the second volume of the "Catalogue photographique du Ciel," giving the rectangular coordinates of some seventy thousand stars between declination +22° and +24°, and the *Annales* for 1902.

Two important pieces of work, the determination of the difference of longitude Greenwich-Paris, and the reduction of the magnitudes and positions of the stars in the cluster Messier 3, were completed.

The programme for the current year includes, among other things, the determination of the constant of aberration by M. Bigourdan, the measurement of stellar radial velocities by M. Hamy, and the photographical record of the ionisation of the atmosphere by M. Nordmann.

ITALIAN OBSERVATIONS OF THE TOTAL SOLAR ECLIPSE (1905).—An interesting illustrated report of the organisation, equipment, and results of the Italian observations of the total eclipse of August last is given by Prof. Ricco in No. 7, vol. xxxv., of the *Memorie della Società degli Spettroscopisti Italiani.*

When first organised, the eclipse party included Prof. Tacchini, and, on his lamented death, the programme proposed had, therefore, to be somewhat modified.

Finally, it was decided that the expedition should make its observations at Alcalà de Chivert, the programme including spectroscopic and direct observations of the prominences, photography of the corona, photographic observations of the spectrum of the eclipsed sun with a slit spectroscope and a prismatic camera, and observations of the solar radiation, the ionisation of the atmosphere, and the polarisation of the coronal radiations.

Although the work was interfered with by clouds, some interesting and valuable observations were made, and are recorded in the article referred to above.

THE SPECTRA OF SUN-SPOTS AND RED STARS.—In a previous paper Profs. Hale and Adams considered the question of the similarity of the spectra of sun-spots and of fourth-type stars, and arrived at the conclusion that the coincidences met with in comparing the spectra suggested the existence of spots, similar to those on the sun, on such stars. Their evidence was confirmed by Sir Norman Lockyer, who further suggested that the temperature conditions of fourth-type stars, taking the absorbing atmospheres as a whole, are about the same as those obtaining in the restricted region of a spot nucleus in the sun's photosphere, both the stellar and the sun-spot atmospheres having a lower temperature than that indicated by the ordinary Fraunhoferic solar spectrum. In a paragraph added to the present paper, reprinted as a Contribution from the Solar Observatory, Mount Wilson (No. 8), Prof. Hale acknowledges the possibility of this suggestion affording the true explanation. Prof. Hale's conclusion was examined by Dr. W. M. Mitchell, who compared his Princeton observations of spot spectra with the star spectra, and was unable to confirm the coincidences of the lines.

In a paper now communicated to No. 5, vol. xxiii., of the *Astrophysical Journal*, Profs. Hale and Adams point out that in the spectra of fourth-type stars the spot lines may be obliterated by bright lines, and that their apparent absence may not, therefore, be accepted as final evidence until better photographs of the fourth-type spectra can be obtained. Such spectra will probably be obtained when the 5-feet reflecting telescope is erected at Mount Wilson and a suitable spectrograph adapted to it. Comparing the spot spectra with the spectrum of α Orionis, the same observers show that the lines of the elements vanadium, titanium, and manganese, which are strongly affected in spot spectra, are also especially strong in this third-type star.

THE BRITISH ASSOCIATION.

SECTION G.

ENGINEERING.

OPENING ADDRESS BY J. A. EWING, LL.D., F.R.S., M.INST.C.E., PRESIDENT OF THE SECTION.

I INTEND to devote this Address to considering in certain aspects the inner structure of metals and the manner in which they yield under strain. It will not be disputed that this is a primary concern of the engineer, who in all his problems of design is confronted by the limitations imposed on him by the strength and elasticity of the materials he employs. It is a leading aim with him to secure lightness and cheapness by giving to the parts such dimensions as are no larger than will secure safety, and hence it is of the first importance to know in each particular case how high a stress may be applied without risk of rupture or of permanent alteration in form. Again, the engineer recognises the merit, for structural purposes, of plasticity as well as strength, and in many of his operations he makes direct use of that property, as in the drawing of wires and tubes or the flanging of plates. He is concerned, too, with the hardening effect that occurs in such processes when work is expended on permanently deforming a metal in the cold state, and also with the restoration to the normal condition of comparative softness which can be brought about by annealing. Nor can he afford to be indifferent to the phenomena of "fatigue" in metals, which manifest themselves when a piece is subjected to repeated alternations or variations of stress—fatigue of strength and fatigue of elasticity, which, like physiological fatigue, admits under some conditions of rest-cure, inasmuch as it tends to disappear with the lapse of time. No apology need be made in selecting for a Presidential Address to Section G a subject that touches so many points of direct practical interest to engineers. It is a subject which has for me the additional attraction of lying in the borderland between engineering and physics—a borderland in which I have often strayed, and still love to stray, and I enter it to-day even at the risk of wandering into regions which, to engineers, may seem a little remote from home, regions where the landscape has, perhaps, a suspicious likeness to that of the country over which the learned men of Section A hold rule.

To engineers, quite as much as to physicists and chemists, we owe in recent years an immense extension of knowledge regarding the structure of metals. This has come about mainly by the intelligent use of the microscope. Take any piece of metal, in the state in which an engineer makes use of it, polish and lightly etch its surface, and examine it under the microscope, and you find that it is a congeries of a multitude of grains, every one of which may be proved to be a crystal. It is true that the boundaries of each grain have none of the characteristics of geometrical regularity which one is apt to look for in a crystal, but the grain is a true crystal for all that. Its boundaries have been determined by the accident of its growth in relation to the simultaneous growth of neighbouring grains—the grains have grown, crystal fashion, until they have met, and the surface of meeting, whatever shape it may happen to take, constitutes the boundary. But within each grain there is the true crystalline characteristic—a regular tactical formation of the little elements of which the crystal is built up. It is as if little fairy children had built the metal by piling brickbats in a nursery. Each child starts wherever it happens to be, placing its first brickbat at random, and then piling the others side by side with the first in geometrical regularity of orientation until the pile, or the branches it shoots out, meets the advancing pile of a neighbour; and so the structure goes on, until the whole space is entirely filled by a solid mass containing as many grains as there have been nuclei from which the growth began.

We now know that this process of crystal growth occurs not only in the solidification of a metal from the liquid state, but in many cases during cooling through a "critical" temperature when the metal is already solid. We know also that the process may in certain conditions go on slowly at very moderate temperatures. We know also that the process of annealing is essentially the raising of the metal to a temperature at which recrystallisation may take place, though the metal remains solid while this internal rearrangement of its particles goes on. Whether crystallisation occurs in solidifying from the liquid or during the cooling of an already solid piece it results in the formation of an aggregate of grains, each one of which is a true crystal. Their size may be large or small—in general, quick cooling means that crystallisation starts from many nuclei, and the resulting grains are consequently small; with very slow cooling you get a gross structure made up of grains of a much larger size.

For simplicity of statement I shall ask you in what follows to confine your attention to simple metals, omitting any reference to alloys. Alloys present many complexities, into which we need not at present enter. With simple metals every crystalline grain is made of the same substance: the elementary brickbats are all exactly alike, though there may be the widest variation from grain to grain as regards the form of the grain, and also as regards the direction in which the elementary brickbats are piled.